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REPORT

JUNE 2018

TOWN OF
Grafton
MASSACHUSETTS

New DPW Facility
Application for Site Plan Review and
Special Permit

TRAFFIC STUDY



Grafton DPW Traffic Analysis June 2018

The Grafton DPW (DPW) is proposing to build a new DPW facility on a site located at 48 Old Westboro Road. The existing DPW Facility is past its useful life and in need of replacement. The Town is proposing a new facility to meet its current needs. The proposed site is currently an un-used brush land located on a 46.99-acre lot owned by the Town of Grafton. The Town is proposing to use roughly 6.4-acres of this lot for the new Facility. The site's main building will be roughly 34,000 square feet, which provides space for employee facilities, works shops, vehicle maintenance, vehicle wash, and vehicle storage. The site will also have a hi-arch gambrel timber framed salt shed, a diesel fuel system, outside bulk storage bins, and stormwater features.

The Facility currently has twelve (12) employees consisting of two (2) mechanics, nine (9) highway employees, and one (1) superintendent. The typical hours of operation for the facility will be Monday through Friday, 7:00am to 3:30pm. It can be assumed that the facility will not be in full operation during the PM peak hours of the local roadway network, found to be 4:45-5:45PM, and therefore will have little to no effect on roadway operations during that time period.

The typical routine for the employees is to arrive at the facility 15 minutes prior to their shift (6:45AM) and leave the facility in DPW vehicles at 7AM to accomplish their daily work assignments. The employees will typically come back to the facility for a 9AM break, back again at noon for lunch and back to work at 12:30PM. At the end of their shifts the employees typically return to the facility at 3:15PM and leave for the day at 3:30PM (with the exception of the Superintendent or Director who may stay longer some days). One of the main duties of the highway facility is to plow snow for Town Roads during snow storms. During snow events highway employees may be required to work throughout the night, where they will mainly be out plowing streets but occasionally need to return to the facility for fuel or salt. However, these vehicle trips occur when there are few other vehicles on the road and may not be during peak hours of the day. The facility will receive deliveries of fuel, salt and other supplies but not typically during the peak traffic hours of the day.

In order to confirm the actual peak hours of operation for the study intersections Turning Movement Counts (TMC) were taken on a weekday in May. The results are indicated in the following table:

Intersection	Exist AM Peak Hour	Exist PM Peak Hour
Old Westboro Road/Estabrook Ave	7:15 – 8:15	4:45 – 5:45
Old Westboro Road/Site Drive	N/A	N/A

The actual TMC's confirm that the AM peak hour will coincide with the time the DPW employees are generally leaving the facility to perform their daily assignments (7AM +/-)

Level of Service (LOS) is an indicator of the operating conditions at a particular intersection or road segment during a particular hour. The LOS rating at an intersection is based upon the calculation of delay per approaching vehicle. The amount of delay is dependent upon many factors such as: traffic volumes, roadway characteristics, speed, and phasing and timing of traffic signals. There are six levels-of-service that are defined. These levels-of-service are expressed by the letters "A" through "F"; "A" being the best (free flow), "F" being the worst (no movement). In practice, any given roadway or intersection may operate at a wide range of LOS ratings depending upon time of day, day of week, or period of year. A LOS rating of "C", a condition of stable flow, is considered desirable for peak or design flow in rural areas. A LOS rating of "D" is considered acceptable in urban areas.

For non-signalized and signalized intersections, LOS is measured in terms of average vehicle delay. Delay time is an indicator of driver comfort and frustration, fuel consumption, and lost productivity due to time delays. The average delay is evaluated using a mathematical model that calculates the number of gaps in the traffic stream that will be available for each minor movement at the intersection. The minor movements consist of all side streets movements plus left turns from the major streets. A basic assumption of this technique is that the major street movements are not hindered by the minor street movements and the left turns from the major streets are made from left turn lanes. The definitions for the LOS ratings at non-signalized

Levels of Service	Non-Signalized	Description
A	<10	Free Flow
B	10 - 15	Reasonably Free Flow
C	15 - 25	Stable Flow
D	25 - 35	Approaching Unstable Flow
E	35 - 50	Unstable Flow
F	> 50	Forced or Breakdown Flow

Based on the actual TMC's for each unsignalized intersection the AM LOS was calculated (see attached Synchro 9.0 Light LOS calculations). The existing AM TMC's for a typical weekday in 2018 were utilized for the existing intersection of Old Westboro/Estabrook and the anticipated employees were used to generate site volumes against the background traffic for the Old Westboro/Site Drive intersection. As a worst-case scenario, the site generated traffic of 8 employees leaving the site assumed that each employee would take a single vehicle versus working two per work assignment for safety reasons and a 50/50 split out of the site. The future 2023 evaluation was based on the existing 2018 TMC's with a conservative 4% background growth rate added to the background 2018 counts and with an additional 4 DPW employees added to the mix.

In addition to the TMC's we collected two-way (N/S) 24 hour volumes on Old Westboro Road from Friday May 4th to Tuesday May 8th to be able to compare volumes for the typical weekday peak hours and a typical Saturday mid-day and peak hours. What we found was a large drop in vehicle volumes on the Saturday peak periods. The Saturday mid-afternoon two-way volume was 308 vehicles, the AM Peak

Hour was 248 vehicles and the PM Peak Hour was 296 vehicles. This compares to the existing weekday two-way AM Peak Hour of over 500 vehicles. For this reason, we stayed with evaluation of the AM Peak Hour of a typical weekday.

The results for the intersections as whole are indicated in the following table for the existing and future Build conditions where it is assumed the DPW site has been built:

Intersection	2018 Build Intxn Delay (sec/veh) AM	2018 Build LOS AM	2023 Build Intxn Delay (sec/veh) PM	2023 Build LOS AM
Old Westboro Road/Estabrook Ave	12.0	B	13.2	B
Old Westboro Road/Site Drive	11.6	B	12.8	B

The LOS evaluation indicated that all of the study intersections operate with minimum delay, at a LOS B during the AM peak hours of typical daily local roadway operations. In addition, all intersection legs were shown to operate a LOS B or better. Further, it can be concluded that if all site generated traffic does not coincide with the AM peak hour and if each work crew has a minimum of 2 employees that the LOS would be better.

A sight distance evaluation was performed on the site driveway based on a 35MPH speed limit (posted speed limit is 30MPH). According to the MassDOT Project Development and Design Guide (PDDG) there are two types of sight distance that need to be considered in this situation; Stopping Sight Distance (SSD), the distance a vehicle traveling on the major roadway needs to stop after seeing the vehicle on the minor roadway/site drive and Intersection Sight Distance (ISD), the distance a vehicle sitting in the site driveway needs to get into the stream of traffic once it sees a vehicle on the major roadway.

Based on a 35MPH design speed the following sight distances are required:

- SSD (Both directions) 257'
- ISD RT (looking to the right w/3% grade) 335'
- ISD LT (looking to the left w/3% grade) 390'

In all cases, there is more than 257' of sight distance to and from the site driveway, therefore, SSD is adequate.

The current sight distance from the site drive to the right appears to be over 335' and therefore adequate.

The current sight distance from the site drive to the left, due to the curve appears to be about 350'. As is this is not adequate. However, with some minor clearing of underbrush and trees the required 390' looks to be attainable.

We conclude, based on the above evaluation, that the introduction of the DPW facility in the proposed location on Old Westboro Road will make a negligible effect on the traffic operations of Old Westboro Road and adjacent roadways.

GRAFTON DPW SITE

Legend



Massachusetts Turnpike (Toll road)



Estabrook Ave

Estabrook Rd

Grafton Rd

APPENDICES

TRAFFIC COUNTS

LOS EVALUATION

SIGHT DISTANCE EVALUATION

TRAFFIC COUNTS

Accurate Counts
978-664-2565

AM PK HR
7:15-8:15 AM

N/S Street : Old Westboro Road
E/W Street : Estabrook Avenue
City/State : Grafton, MA
Weather : Clear

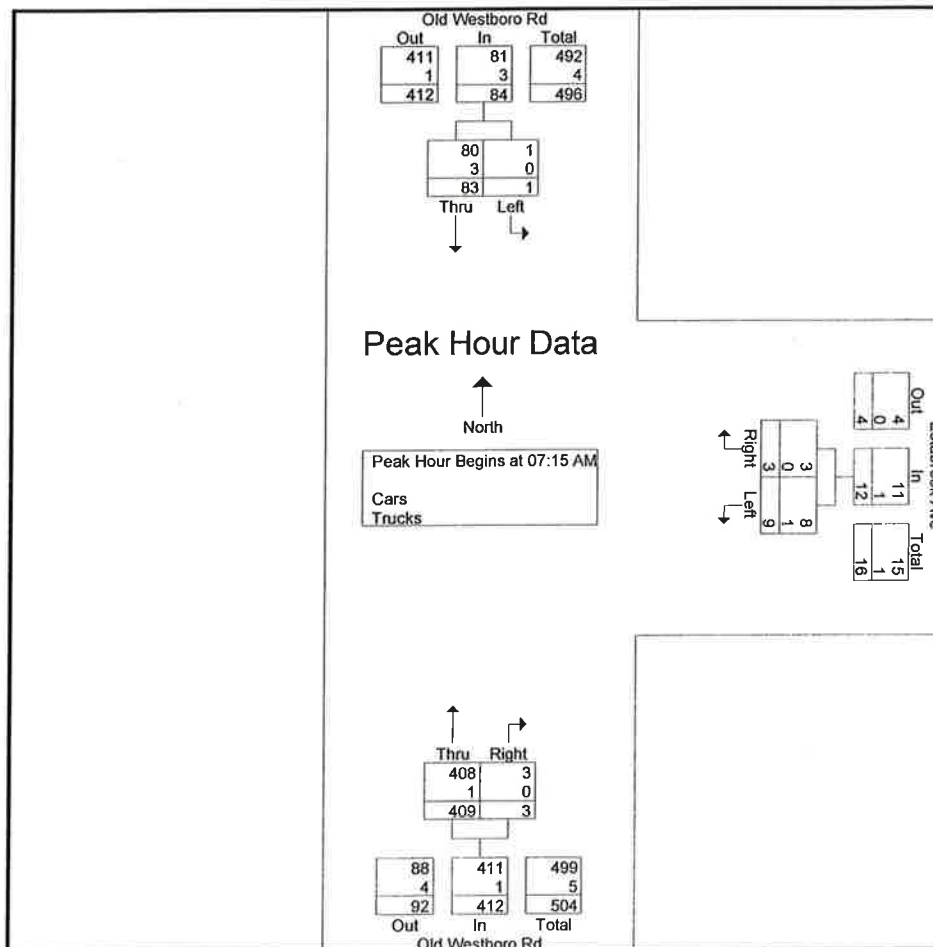
File Name : 80199001
Site Code : 80199001
Start Date : 5/3/2018
Page No : 2

	Old Westboro Rd From North SB			Estabrook Ave From East WB			Old Westboro Rd From South NB			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total

Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1

Peak Hour for Entire Intersection Begins at 07:15 AM

07:15 AM	0	22	22	1	0	1	95	1	96	119
07:30 AM	1	17	18	1	1	2	95	0	95	115
07:45 AM	0	32	32	4	1	5	103	1	104	141
08:00 AM	0	12	12	3	1	4	116	1	117	133
Total Volume	1	83	84	9	3	12	409	3	412	508
% App. Total	1.2	98.8		75	25		99.3	0.7		
PHF	.250	.648	.656	.563	.750	.600	.881	.750	.880	.901
Cars	1	80	81	8	3	11	408	3	411	503
% Cars	100	96.4	96.4	88.9	100	91.7	99.8	100	99.8	99.0
Trucks	0	3	3	1	0	1	1	0	1	5
% Trucks	0	3.6	3.6	11.1	0	8.3	0.2	0	0.2	1.0



Accurate Counts
978-664-2565

N/S Street : Old Westboro Road
E/W Street : Estabrook Avenue
City/State : Grafton, MA
Weather : Clear

File Name : 80199001
Site Code : 80199001
Start Date : 5/3/2018
Page No : 1

Groups Printed- Cars - Trucks

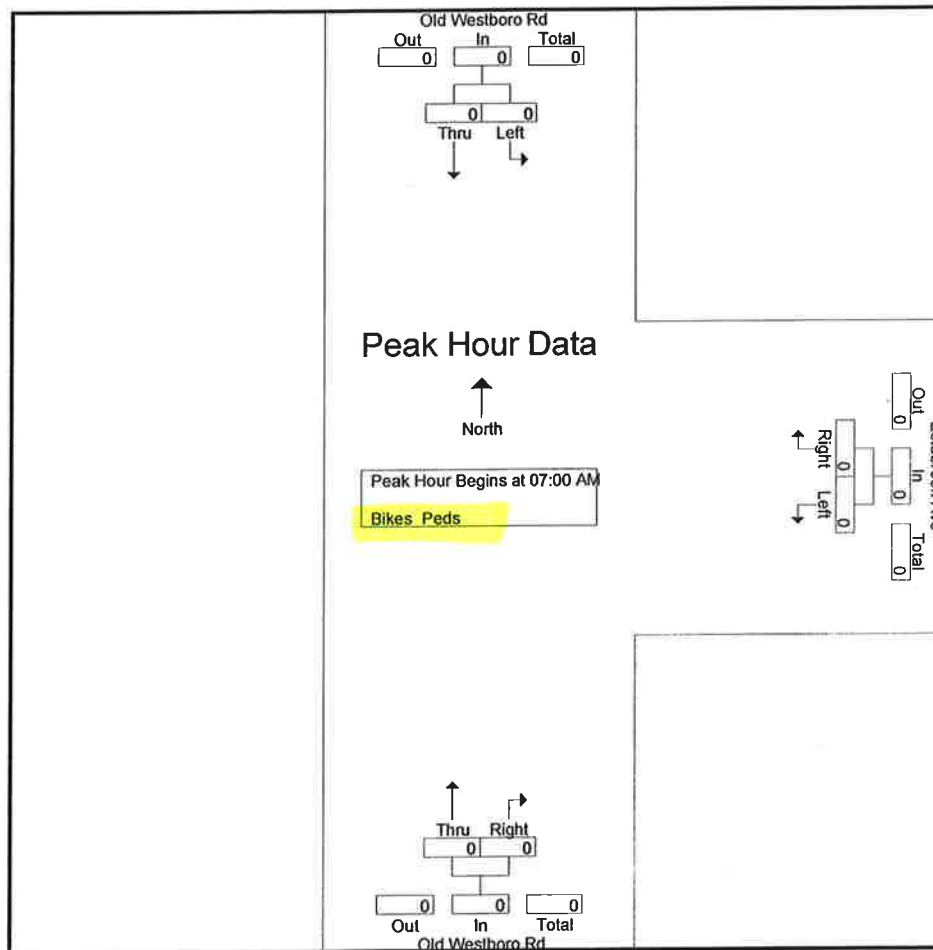
Start Time	Old Westboro Rd From North		Estabrook Ave From East		Old Westboro Rd From South		Int. Total
	Left	Thru	Left	Right	Thru	Right	
07:00 AM	0	23	1	0	86	2	112
07:15 AM	0	22	1	0	95	1	119
07:30 AM	1	17	1	1	95	0	115
07:45 AM	0	32	4	1	103	1	141
Total	1	94	7	2	379	4	487
08:00 AM	0	12	3	1	116	1	133
08:15 AM	1	21	0	0	90	0	112
08:30 AM	1	28	1	0	68	0	98
08:45 AM	0	12	1	1	61	0	75
Total	2	73	5	2	335	1	418
Grand Total	3	167	12	4	714	5	905
Apprch %	1.8	98.2	75	25	99.3	0.7	
Total %	0.3	18.5	1.3	0.4	78.9	0.6	
Cars	3	162	11	4	709	5	894
% Cars	100	97	91.7	100	99.3	100	98.8
Trucks	0	5	1	0	5	0	11
% Trucks	0	3	8.3	0	0.7	0	1.2

Accurate Counts
978-664-2565

N/S Street : Old Westboro Road
E/W Street : Estabrook Avenue
City/State : Grafton, MA
Weather : Clear

File Name : 80199001
Site Code : 80199001
Start Date : 5/3/2018
Page No : 11

	Old Westboro Rd From North			Estabrook Ave From East			Old Westboro Rd From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 08:45 AM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 07:00 AM										
07:00 AM	0	0	0	0	0	0	0	0	0	0
07:15 AM	0	0	0	0	0	0	0	0	0	0
07:30 AM	0	0	0	0	0	0	0	0	0	0
07:45 AM	0	0	0	0	0	0	0	0	0	0
Total Volume	0	0	0	0	0	0	0	0	0	0
% App. Total	0	0	0	0	0	0	0	0	0	0
PHF	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000



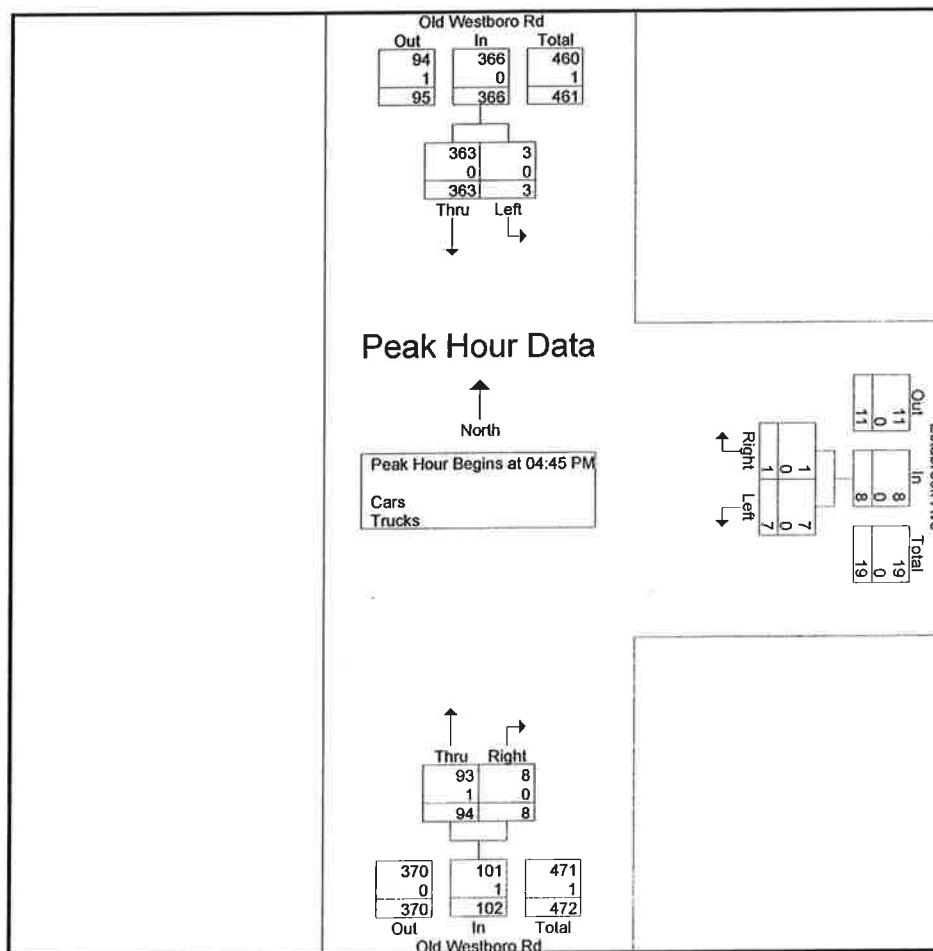
Accurate Counts
978-664-2565

PM PK HR
4:45-5:45 PM

N/S Street : Old Westboro Road
E/W Street : Estabrook Avenue
City/State : Grafton, MA
Weather : Clear

File Name : 80199001
Site Code : 80199001
Start Date : 5/3/2018
Page No : 2

	Old Westboro Rd From North			Estabrook Ave From East			Old Westboro Rd From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 04:45 PM										
04:45 PM	1	87	88	2	1	3	16	3	19	110
05:00 PM	0	96	96	2	0	2	27	3	30	128
05:15 PM	1	98	99	1	0	1	28	2	30	130
05:30 PM	1	82	83	2	0	2	23	0	23	108
Total Volume	3	363	366	7	1	8	94	8	102	476
% App. Total	0.8	99.2		87.5	12.5		92.2	7.8		
PHF	.750	.926	.924	.875	.250	.667	.839	.667	.850	.915
Cars	3	363	366	7	1	8	93	8	101	475
% Cars	100	100	100	100	100	100	98.9	100	99.0	99.8
Trucks	0	0	0	0	0	0	1	0	1	1
% Trucks	0	0	0	0	0	0	1.1	0	1.0	0.2



Accurate Counts

978-664-2565

N/S Street : Old Westboro Road
E/W Street : Estabrook Avenue
City/State : Grafton, MA
Weather : Clear

File Name : 80199001
Site Code : 80199001
Start Date : 5/3/2018
Page No : 1

Groups Printed- Cars - Trucks

Start Time	Old Westboro Rd From North		Estabrook Ave From East		Old Westboro Rd From South		Int. Total
	Left	Thru	Left	Right	Thru	Right	
04:00 PM	1	62	0	0	33	4	100
04:15 PM	1	57	2	0	23	1	84
04:30 PM	0	69	1	0	30	1	101
04:45 PM	1	87	2	1	16	3	110
Total	3	275	5	1	102	9	395
05:00 PM	0	96	2	0	27	3	128
05:15 PM	1	98	1	0	28	2	130
05:30 PM	1	82	2	0	23	0	108
05:45 PM	0	69	1	0	24	1	95
Total	2	345	6	0	102	6	461
Grand Total	5	620	11	1	204	15	856
Apprch %	0.8	99.2	91.7	8.3	93.2	6.8	
Total %	0.6	72.4	1.3	0.1	23.8	1.8	
Cars	5	620	11	1	202	15	854
% Cars	100	100	100	100	99	100	99.8
Trucks	0	0	0	0	2	0	2
% Trucks	0	0	0	0	1	0	0.2

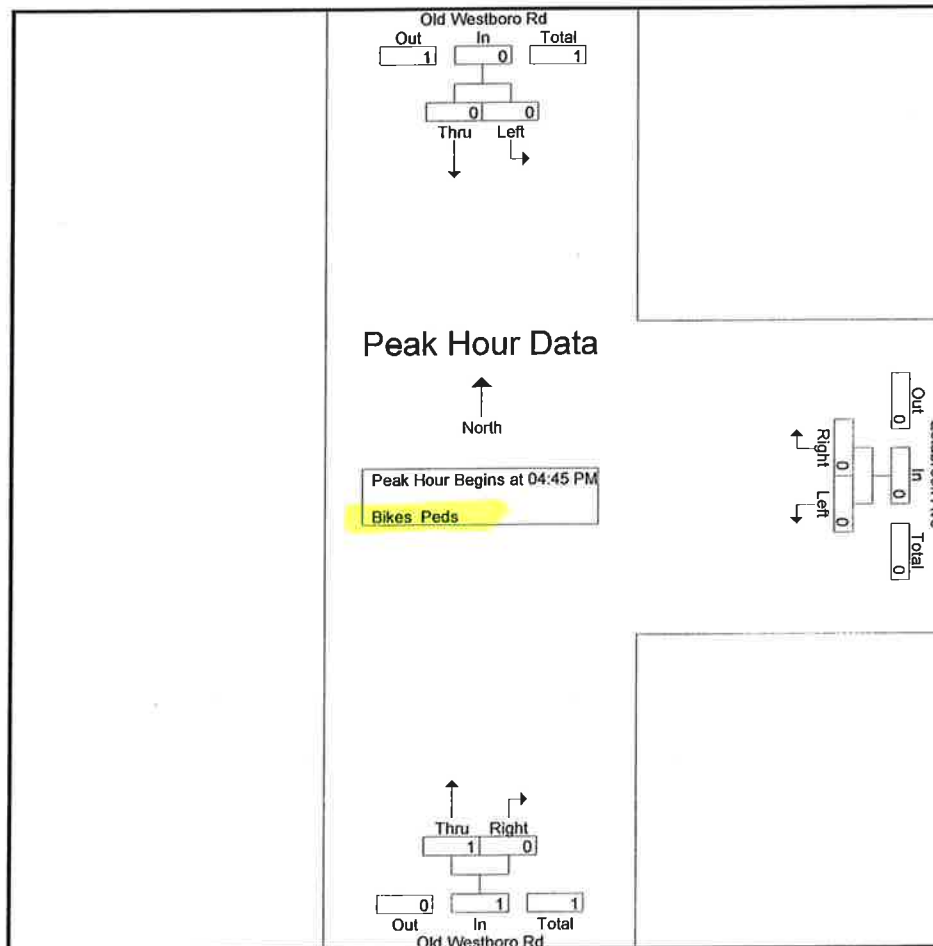
Accurate Counts

978-664-2565

N/S Street : Old Westboro Road
 E/W Street : Estabrook Avenue
 City/State : Grafton, MA
 Weather : Clear

File Name : 80199001
 Site Code : 80199001
 Start Date : 5/3/2018
 Page No : 11

	Old Westboro Rd From North			Estabrook Ave From East			Old Westboro Rd From South			
Start Time	Left	Thru	App. Total	Left	Right	App. Total	Thru	Right	App. Total	Int. Total
Peak Hour Analysis From 04:00 PM to 05:45 PM - Peak 1 of 1										
Peak Hour for Entire Intersection Begins at 04:45 PM										
04:45 PM	0	0	0	0	0	0	0	0	0	0
05:00 PM	0	0	0	0	0	0	0	0	0	0
05:15 PM	0	0	0	0	0	0	0	0	0	0
05:30 PM	0	0	0	0	0	0	1	0	1	1
Total Volume	0	0	0	0	0	0	1	0	1	1
% App. Total	0	0		0	0		100	0		
PHF	.000	.000	.000	.000	.000	.000	.250	.000	.250	.250



24HR VOL
SB/NB

Accurate Counts
978-664-2565

Page 1

Location : Old Westboro Road
Location : South of Estabrook Avenue
City/State: Grafton, MA

80199VOL

Start Time	5/4/2018 Fri	SB		Hour Totals		NB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		3	37			0	22				
12:15		2	32			0	18				
12:30		1	23			0	29				
12:45		1	27	7	119	0	26	0	95	7	214
01:00		2	28			1	24				
01:15		5	29			0	30				
01:30		2	36			1	23				
01:45		1	30	10	123	2	27	4	104	14	227
02:00		1	36			0	31				
02:15		7	34			3	27				
02:30		2	38			1	34				
02:45		2	39	12	147	1	23	5	115	17	282
03:00		0	30			1	30				
03:15		1	59			1	28				
03:30		0	45			3	32				
03:45		0	51	1	185	1	34	6	124	7	309
04:00		0	58			4	26				
04:15		2	85			3	36				
04:30		2	72			6	32				
04:45		1	69	5	284	9	41	22	135	27	419
05:00		2	71			9	30				
05:15		3	95			5	36				
05:30		0	88			17	26				
05:45		1	69	6	323	27	33	58	125	64	448
06:00		6	68			20	22				
06:15		5	59			39	32				
06:30		8	43			55	26				
06:45		23	51	42	221	59	18	173	98	215	319
07:00		16	49			79	18				
07:15		28	37			84	19				
07:30		18	25			87	15				
07:45		39	32	101	143	100	25	350	77	451	220
08:00		25	14			70	10				
08:15		20	22			89	12				
08:30		28	22			63	8				
08:45		19	28	92	86	60	8	282	38	374	124
09:00		17	23			38	11				
09:15		22	13			37	15				
09:30		13	13			28	8				
09:45		14	12	66	61	25	8	128	42	194	103
10:00		20	13			18	6				
10:15		20	14			28	9				
10:30		22	9			25	9				
10:45		18	11	80	47	17	10	88	34	168	81
11:00		22	12			28	5				
11:15		25	9			35	3				
11:30		25	3			28	1				
11:45		16	4	88	28	20	5	111	14	199	42
Total		510	1767			1227	1001			1737	2768
Percent		22.4%	77.6%			55.1%	44.9%			38.6%	61.4%

Accurate Counts

978-664-2565

Page 2

Location : Old Westboro Road
Location : South of Estabrook Avenue
City/State: Grafton, MA

80199VOL

Start Time	5/5/2018 Sat	SB		Hour Totals		NB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		7	38			4	20				
12:15		3	38			1	61				
12:30		2	28			1	31				
12:45		0	33	12	137	1	39	7	151	19	288
01:00		6	35		134	1	43		174		308
01:15		2	39		135	0	28		141		276
01:30		1	28		135	0	23		133		268
01:45		2	37	11	139	0	22	1	116	12	255
02:00		1	26		130	1	25		98		228
02:15		1	36		127	2	24		94		221
02:30		2	32		131	2	24		95		226
02:45		1	26	5	120	0	24	5	97	10	217
03:00		0	36			0	24				
03:15		2	35			3	30				
03:30		1	44			0	26				
03:45		1	30	4	145	1	27	4	107	8	252
04:00		0	33			0	23				
04:15		1	32			4	24				
04:30		0	30			2	29				
04:45		2	36	3	131	1	32	7	108	10	239
05:00		1	29			1	23				
05:15		2	28			3	21				
05:30		0	58			7	20				
05:45		5	25	8	140	8	23	19	87	27	227
06:00		1	29			5	18				
06:15		2	26			10	27				
06:30		5	18			13	25				
06:45		5	20	13	93	9	21	37	91	50	184
07:00		9	13			19	15				
07:15		12	16			16	16				
07:30		9	17			18	20				
07:45		19	22	49	68	22	9	75	60	124	128
08:00		11	17			29	7				
08:15		20	13			17	16				
08:30		18	22			21	18				
08:45		20	15	69	67	26	6	93	47	162	114
09:00		22	18			25	6				
09:15		26	7			32	11				
09:30		25	14			47	10				
09:45		26	14	99	53	28	10	132	37	231	90
10:00		24	18	101		34	12	141		242	
10:15		30	15	105		21	10	130		235	
10:30		24	10	104		20	14	113		207	
10:45		18	17	96	60	27	7	102	43	198	103
11:00		26	6	98		33	8	101		199	
11:15		28	11	96		26	3	106		202	
11:30		33	4	105		24	3	110		215	
11:45		29	7	116	28	35	5	118	19	234	47
Total		485	1181			600	963			1085	2144
Percent		29.1%	70.9%			38.4%	61.6%			33.6%	66.4%

* SAT MID AFT PK HR (LOOK @ 11AM-3PM)
12:15-1:15 PM
TOT VOL 308 VEH (NB/SB)

Accurate Counts

Page 3

Location : Old Westboro Road
 Location : South of Estabrook Avenue
 City/State: Grafton, MA

978-664-2565

80199VOL

Start Time	5/6/2018 Sun	SB		Hour Totals		NB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		6	30			1	32				
12:15		7	38			2	23				
12:30		6	29			3	30				
12:45		2	34	21	129	3	30	9	115	30	244
01:00		1	23			0	25				
01:15		2	18			0	19				
01:30		1	25			0	32				
01:45		5	30	9	96	0	24	0	100	9	196
02:00		1	30			0	22				
02:15		3	41			0	23				
02:30		1	22			2	25				
02:45		1	30	6	123	0	19	2	89	8	212
03:00		1	35			0	21				
03:15		1	23			0	20				
03:30		1	26			0	18				
03:45		1	24	4	108	3	20	3	79	7	167
04:00		0	28			2	24				
04:15		0	24			2	19				
04:30		0	25			1	34				
04:45		2	25	2	102	1	22	6	99	8	201
05:00		1	34			3	20				
05:15		1	25			0	20				
05:30		0	24			2	14				
05:45		0	18	2	101	2	16	7	70	9	171
06:00		1	15			4	22				
06:15		1	18			5	17				
06:30		0	16			9	12				
06:45		2	18	4	67	5	15	23	66	27	133
07:00		4	23			9	11				
07:15		2	17			8	11				
07:30		5	13			9	10				
07:45		1	13	12	66	14	12	40	44	52	110
08:00		7	12			11	6				
08:15		13	12			16	16				
08:30		17	12			15	9				
08:45		19	9	56	45	22	8	64	39	120	84
09:00		15	16			23	2				
09:15		15	6			14	5				
09:30		10	2			18	5				
09:45		19	4	59	28	19	2	74	14	133	42
10:00		18	6			19	0				
10:15		20	2			28	4				
10:30		28	3			39	2				
10:45		26	0	92	11	24	5	110	11	202	22
11:00		41	3			24	1				
11:15		38	4			19	1				
11:30		23	1			23	1				
11:45		17	3	119	11	32	0	98	3	217	14
Total		386	887			436	729			822	1616
Percent		30.3%	69.7%			37.4%	62.6%			33.7%	66.3%

Accurate Counts

978-664-2565

Page 4

Location : Old Westboro Road
Location : South of Estabrook Avenue
City/State: Grafton, MA

80199VOL

Start Time	5/7/2018 Mon	SB		Hour Totals		NB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		5	22			0	32				
12:15		0	25			0	29				
12:30		1	26			2	31				
12:45		0	30	6	103	0	27	2	119	8	222
01:00		1	21			0	21				
01:15		1	30			0	25				
01:30		0	30			0	22				
01:45		1	32	3	113	0	36	0	104	3	217
02:00		0	37			1	24				
02:15		0	41			0	24				
02:30		0	31			2	36				
02:45		0	64	0	173	1	30	4	114	4	287
03:00		1	46			2	22				
03:15		1	43			1	27				
03:30		2	52			1	29				
03:45		0	47	4	188	1	32	5	110	9	298
04:00		1	55			1	23				
04:15		1	74			3	23				
04:30		0	82			5	29				
04:45		2	72	4	283	8	31	17	106	21	389
05:00		3	94			10	30				
05:15		2	86			10	31				
05:30		0	91			19	15				
05:45		3	62	8	333	24	32	63	108	71	441
06:00		4	58			31	33				
06:15		6	50			40	19				
06:30		9	44			62	15				
06:45		25	39	44	191	81	28	214	95	258	286
07:00		28	39			80	11				
07:15		29	36			96	23				
07:30		12	26			111	16				
07:45		30	22	99	123	107	9	394	59	493	182
08:00		21	25			106	11				
08:15		22	20			86	11				
08:30		19	19			68	10				
08:45		16	30	78	94	50	8	310	40	388	134
09:00		15	14			47	9				
09:15		14	13			32	4				
09:30		16	10			38	6				
09:45		29	7	74	44	25	5	142	24	216	68
10:00		17	8			28	8				
10:15		23	5			24	2				
10:30		30	5			20	6				
10:45		27	4	97	22	21	2	93	18	190	40
11:00		25	10			33	4				
11:15		19	3			30	4				
11:30		24	2			22	1				
11:45		20	3	88	18	26	2	111	11	199	29
Total		505	1685			1355	908			1860	2593
Percent		23.1%	76.9%			59.9%	40.1%			41.8%	58.2%

Accurate Counts

978-664-2565

Page 5

Location : Old Westboro Road
Location : South of Estabrook Avenue
City/State: Grafton, MA

80199VOL

Start Time	5/8/2018 Tue	SB		Hour Totals		NB		Hour Totals		Combined Totals	
		Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
12:00		3	25			0	27				
12:15		1	30			0	23				
12:30		1	31			0	28				
12:45		1	22	6	108	1	20	1	98	7	206
01:00		0	25			0	20				
01:15		0	19			0	12				
01:30		1	32			1	25				
01:45		1	31	2	107	0	24	1	81	3	188
02:00		0	33			1	37				
02:15		0	43			0	28				
02:30		1	41			2	30				
02:45		0	46	1	163	1	27	4	122	5	285
03:00		0	43			0	37				
03:15		1	56			3	27				
03:30		3	53			1	37				
03:45		1	64	5	216	2	30	6	131	11	347
04:00		1	54			1	34				
04:15		0	66			4	28				
04:30		3	74			8	15				
04:45		0	72	4	266	5	31	18	108	22	374
05:00		6	89			6	31				
05:15		2	93			11	22				
05:30		3	85			24	26				
05:45		4	86	15	353	25	24	66	103	81	456
06:00		4	68			32	22				
06:15		7	59			44	18				
06:30		10	45			50	30				
06:45		28	36	49	208	81	26	207	96	256	304
07:00		23	39			88	21				
07:15		24	28			109	23				
07:30		22	34			99	26				
07:45		27	31	96	132	114	26	410	96	506	228
08:00		24	21			98	16				
08:15		21	28			120	19				
08:30		18	18			78	8				
08:45		26	36	89	103	62	10	358	53	447	156
09:00		26	18			53	5				
09:15		24	33			50	13				
09:30		19	10			36	10				
09:45		27	10	96	71	31	2	170	30	266	101
10:00		16	14			27	3				
10:15		29	7			27	6				
10:30		21	7			25	4				
10:45		28	2	94	30	25	3	104	16	198	46
11:00		21	4			23	1				
11:15		21	9			29	2				
11:30		28	10			21	1				
11:45		23	0	93	23	26	0	99	4	192	27
Total		550	1780			1444	938			1994	2718
Percent		23.6%	76.4%			60.6%	39.4%			42.3%	57.7%
Grand Total		2436	7300			5062	4539			7498	11839
Percent		25.0%	75.0%			52.7%	47.3%			38.8%	61.2%
ADT		ADT 3,867	AADT 3,867								

203

5.6.18

Start Time	4/30/2018		Tue		Wed		Thu		Fri		Sat		Sun		Week Average	
	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
12:00 AM	*	*	*	*	*	*	*	*	7	0	12	7	21	9	13	5
01:00	*	*	*	*	*	*	*	*	10	4	11	1	9	0	10	2
02:00	*	*	*	*	*	*	*	*	12	5	5	5	6	2	8	4
03:00	*	*	*	*	*	*	*	*	1	6	4	4	4	3	3	4
04:00	*	*	*	*	*	*	*	*	5	22	3	7	2	6	3	12
05:00	*	*	*	*	*	*	*	*	6	58	8	19	2	7	5	28
06:00	*	*	*	*	*	*	*	*	42	173	13	37	4	23	20	78
07:00	*	*	*	*	*	*	*	*	101	350	49	75	12	40	54	155
08:00	*	*	*	*	*	*	*	*	92	282	69	93	56	64	72	146
09:00	*	*	*	*	*	*	*	*	66	128	99	132	59	74	75	111
10:00	*	*	*	*	*	*	*	*	80	88	96	102	92	110	89	100
11:00	*	*	*	*	*	*	*	*	88	111	116	118	119	98	108	109
12:00 PM	*	*	*	*	*	*	*	*	119	95	137	151	129	115	128	120
01:00	*	*	*	*	*	*	*	*	123	104	139	116	96	100	119	107
02:00	*	*	*	*	*	*	*	*	147	115	120	97	123	89	130	100
03:00	*	*	*	*	*	*	*	*	185	124	145	107	108	79	146	103
04:00	*	*	*	*	*	*	*	*	284	135	131	108	102	99	172	114
05:00	*	*	*	*	*	*	*	*	323	125	140	87	101	70	188	94
06:00	*	*	*	*	*	*	*	*	221	98	93	91	67	66	127	85
07:00	*	*	*	*	*	*	*	*	143	77	68	60	66	44	92	60
08:00	*	*	*	*	*	*	*	*	86	38	67	47	45	39	66	41
09:00	*	*	*	*	*	*	*	*	61	42	53	37	28	14	47	31
10:00	*	*	*	*	*	*	*	*	47	34	60	43	11	11	39	29
11:00	*	*	*	*	*	*	*	*	28	14	28	19	11	3	22	12
Lane	0	0	0	0	0	0	0	0	2277	2228	1666	1563	1273	1165	1736	1650
Day	0	0	0	0	0	0	0	0	4505	3229	3229	2438	3386			
AM Peak Vol.	-	-	-	-	-	-	-	-	07:00	07:00	11:00	09:00	11:00	10:00	11:00	07:00
PM Peak Vol.	-	-	-	-	-	-	-	-	17:00	16:00	15:00	12:00	12:00	12:00	17:00	12:00
	-	-	-	-	-	-	-	-	323	135	145	151	129	115	188	120

Accurate Counts

978-664-2565

Location : Old Westboro Road
 Location : South of Estabrook Avenue
 City/State: Grafton, MA

80199VOL

5.8.18

Start Time	5/7/2018	Tue		Wed		Thu		Fri		Sat		Sun		Week Average	
	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	
12:00 AM	6	2	6	1	*	*	*	*	*	*	*	*	*	6	2
01:00	3	0	2	1	*	*	*	*	*	*	*	*	*	2	0
02:00	0	4	1	4	*	*	*	*	*	*	*	*	*	0	4
03:00	4	5	5	6	*	*	*	*	*	*	*	*	*	4	6
04:00	4	17	4	18	*	*	*	*	*	*	*	*	*	4	18
05:00	8	63	15	66	*	*	*	*	*	*	*	*	*	12	64
06:00	44	214	49	207	*	*	*	*	*	*	*	*	*	46	210
07:00	99	394	96	410	*	*	*	*	*	*	*	*	*	98	402
08:00	78	310	89	358	*	*	*	*	*	*	*	*	*	84	334
09:00	74	142	96	170	*	*	*	*	*	*	*	*	*	85	156
10:00	97	93	94	104	*	*	*	*	*	*	*	*	*	96	98
11:00	88	111	93	99	*	*	*	*	*	*	*	*	*	90	105
12:00 PM	103	119	108	98	*	*	*	*	*	*	*	*	*	106	108
01:00	113	104	107	81	*	*	*	*	*	*	*	*	*	110	92
02:00	173	114	163	122	*	*	*	*	*	*	*	*	*	168	118
03:00	188	110	216	131	*	*	*	*	*	*	*	*	*	202	120
04:00	283	106	266	108	*	*	*	*	*	*	*	*	*	274	107
05:00	333	108	353	103	*	*	*	*	*	*	*	*	*	343	106
06:00	191	95	208	96	*	*	*	*	*	*	*	*	*	200	96
07:00	123	59	132	96	*	*	*	*	*	*	*	*	*	128	78
08:00	94	40	103	53	*	*	*	*	*	*	*	*	*	98	46
09:00	44	24	71	30	*	*	*	*	*	*	*	*	*	58	27
10:00	22	18	30	16	*	*	*	*	*	*	*	*	*	26	17
11:00	18	11	23	4	*	*	*	*	*	*	*	*	*	20	8
Lane	2190	2263	2330	2382	0	0	0	0	0	0	0	0	0	2260	2322
Day	4453		4712		0	0	0	0	0	0	0	0	0	4582	
AM Peak	07:00	07:00	07:00	07:00	-	-	-	-	-	-	-	-	-	07:00	07:00
Vol.	99	394	96	410	-	-	-	-	-	-	-	-	-	98	402
PM Peak	17:00	12:00	17:00	15:00	-	-	-	-	-	-	-	-	-	17:00	15:00
Vol.	333	119	353	131	-	-	-	-	-	-	-	-	-	343	120

Comb. Total

4453

4712

0

0

4505

3229

2438

7968

ADT

ADT 3,867

AADT 3,867










LOS EVALUATION

HCM Unsignalized Intersection Capacity Analysis

9: ESTABROOK AVE & OLD WESTBORO RD

AM EXIST 2018

05/22/2018

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	9	3	408	3	1	83
Future Volume (Veh/h)	9	3	408	3	1	83
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	10	3	443	3	1	90
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	536	444			446	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	536	444			446	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	100			100	
cM capacity (veh/h)	505	614			1114	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	13	446	91			
Volume Left	10	0	1			
Volume Right	3	3	0			
cSH	526	1700	1114			
Volume to Capacity	0.02	0.26	0.00			
Queue Length 95th (ft)	2	0	0			
Control Delay (s)	12.0	0.0	0.1			
Lane LOS	B		A			
Approach Delay (s)	12.0	0.0	0.1			
Approach LOS	B					
Intersection Summary						
Average Delay			0.3			
Intersection Capacity Utilization			31.7%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

11: OLD WESTBORO RD & GRAFTON DPW DW

AM EXIST 2018

05/22/2018












Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	4	4	407	4	4	80
Future Volume (Veh/h)	4	4	407	4	4	80
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	4	4	442	4	4	87
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	539	444			446	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	539	444			446	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	99	99			100	
cM capacity (veh/h)	502	614			1114	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	8	446	91			
Volume Left	4	0	4			
Volume Right	4	4	0			
cSH	552	1700	1114			
Volume to Capacity	0.01	0.26	0.00			
Queue Length 95th (ft)	1	0	0			
Control Delay (s)	11.6	0.0	0.4			
Lane LOS	B		A			
Approach Delay (s)	11.6	0.0	0.4			
Approach LOS	B					
Intersection Summary						
Average Delay			0.2			
Intersection Capacity Utilization			31.7%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis

9: ESTABROOK AVE & OLD WESTBORO RD

AM FUTURE 2023










06/05/2018

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	11	4	496	4	2	101
Future Volume (Veh/h)	11	4	496	4	2	101
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	12	4	539	4	2	110
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	655	541			543	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	655	541			543	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	97	99			100	
cM capacity (veh/h)	430	541			1026	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	16	543	112			
Volume Left	12	0	2			
Volume Right	4	4	0			
cSH	453	1700	1026			
Volume to Capacity	0.04	0.32	0.00			
Queue Length 95th (ft)	3	0	0			
Control Delay (s)	13.2	0.0	0.2			
Lane LOS	B		A			
Approach Delay (s)	13.2	0.0	0.2			
Approach LOS	B					
Intersection Summary						
Average Delay		0.3				
Intersection Capacity Utilization		36.3%		ICU Level of Service		A
Analysis Period (min)		15				

HCM Unsignalized Intersection Capacity Analysis 11: OLD WESTBORO RD & GRAFTON DPW DW

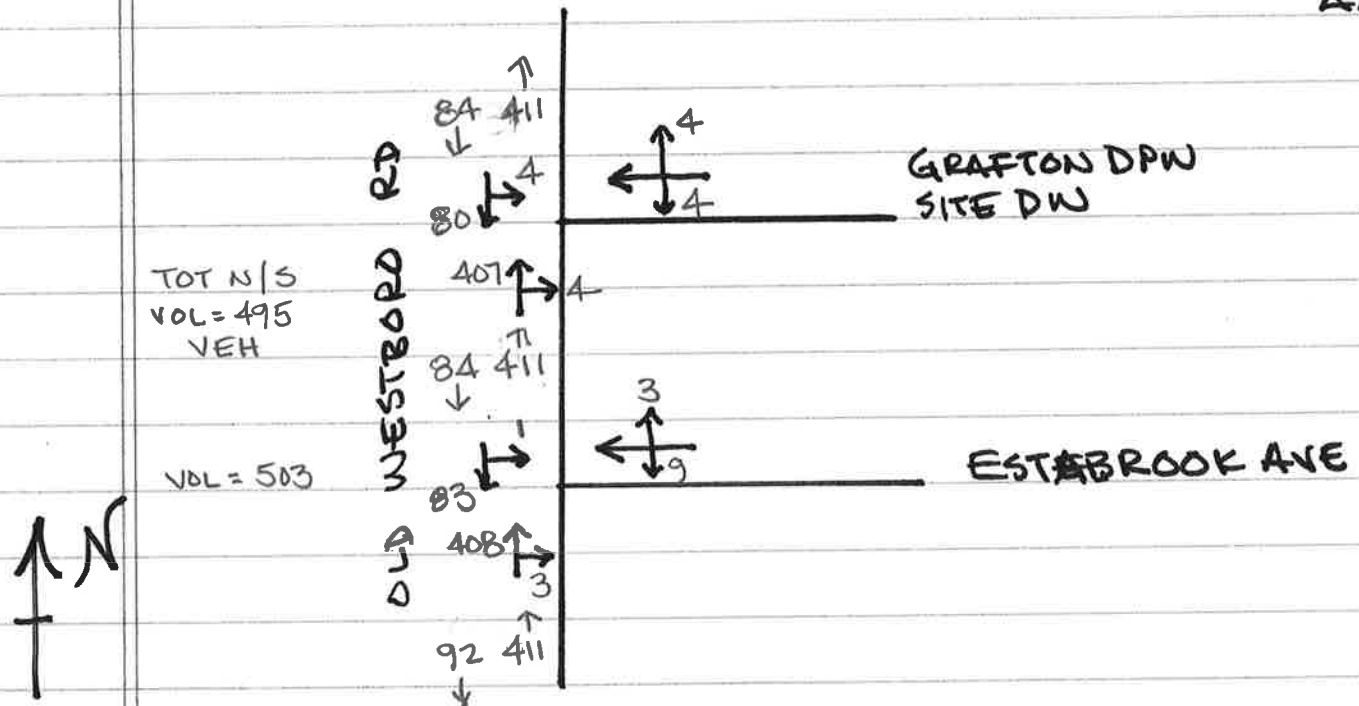
AM FUTURE 2023

06/05/2018

						
Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	6	6	494	6	6	97
Future Volume (Veh/h)	6	6	494	6	6	97
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	7	7	537	7	7	105
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	660	540			544	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	660	540			544	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	98	99			99	
cM capacity (veh/h)	425	541			1025	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	14	544	112			
Volume Left	7	0	7			
Volume Right	7	7	0			
cSH	476	1700	1025			
Volume to Capacity	0.03	0.32	0.01			
Queue Length 95th (ft)	2	0	1			
Control Delay (s)	12.8	0.0	0.6			
Lane LOS	B		A			
Approach Delay (s)	12.8	0.0	0.6			
Approach LOS	B					
Intersection Summary						
Average Delay			0.4			
Intersection Capacity Utilization		36.4%		ICU Level of Service		A
Analysis Period (min)		15				

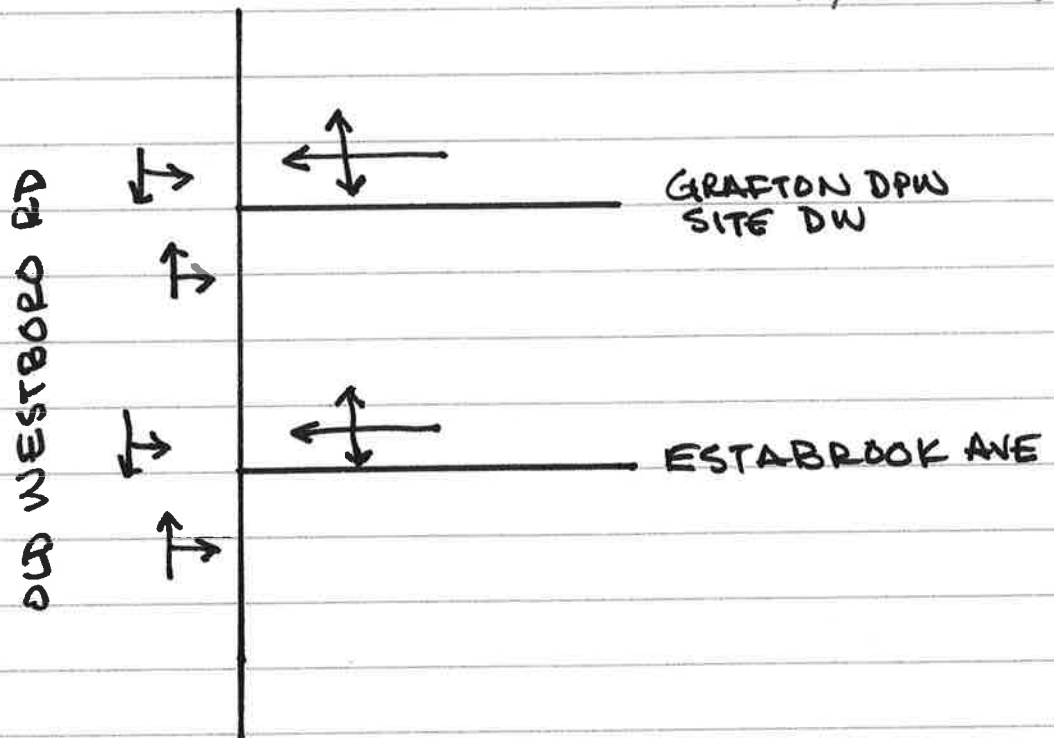
EXIST.
2018

AM

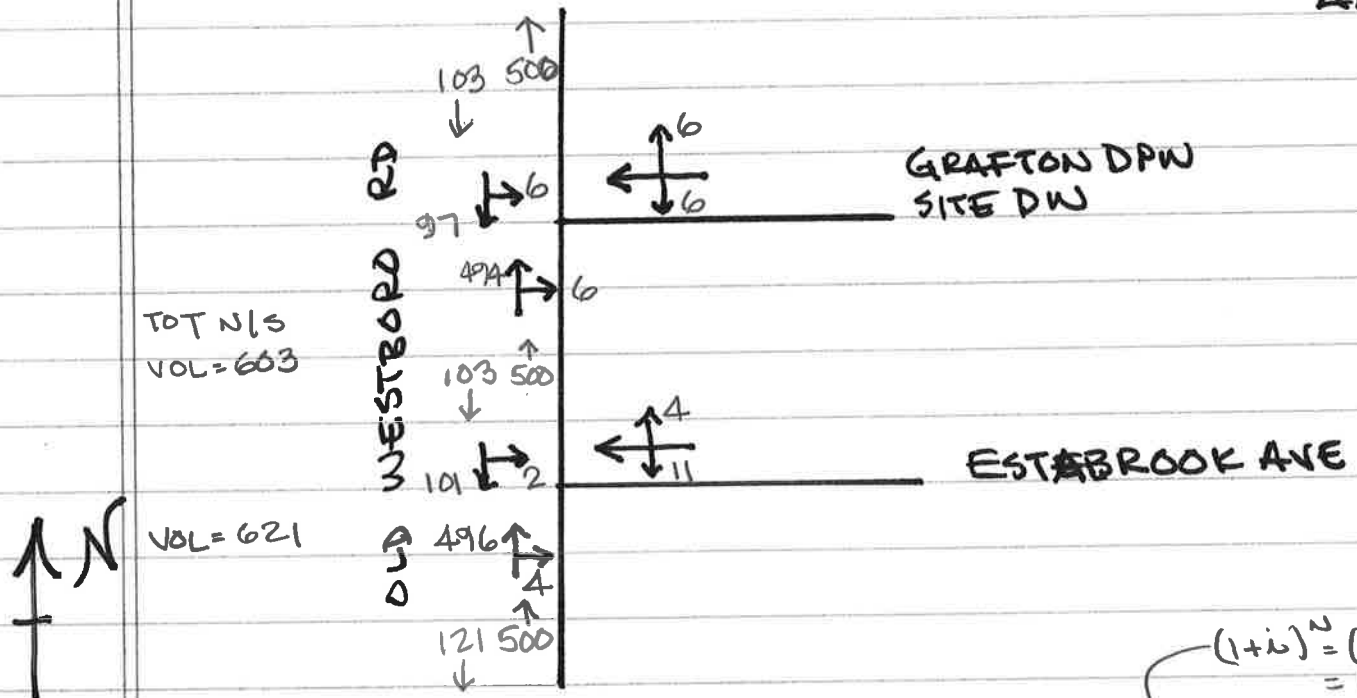


N/A

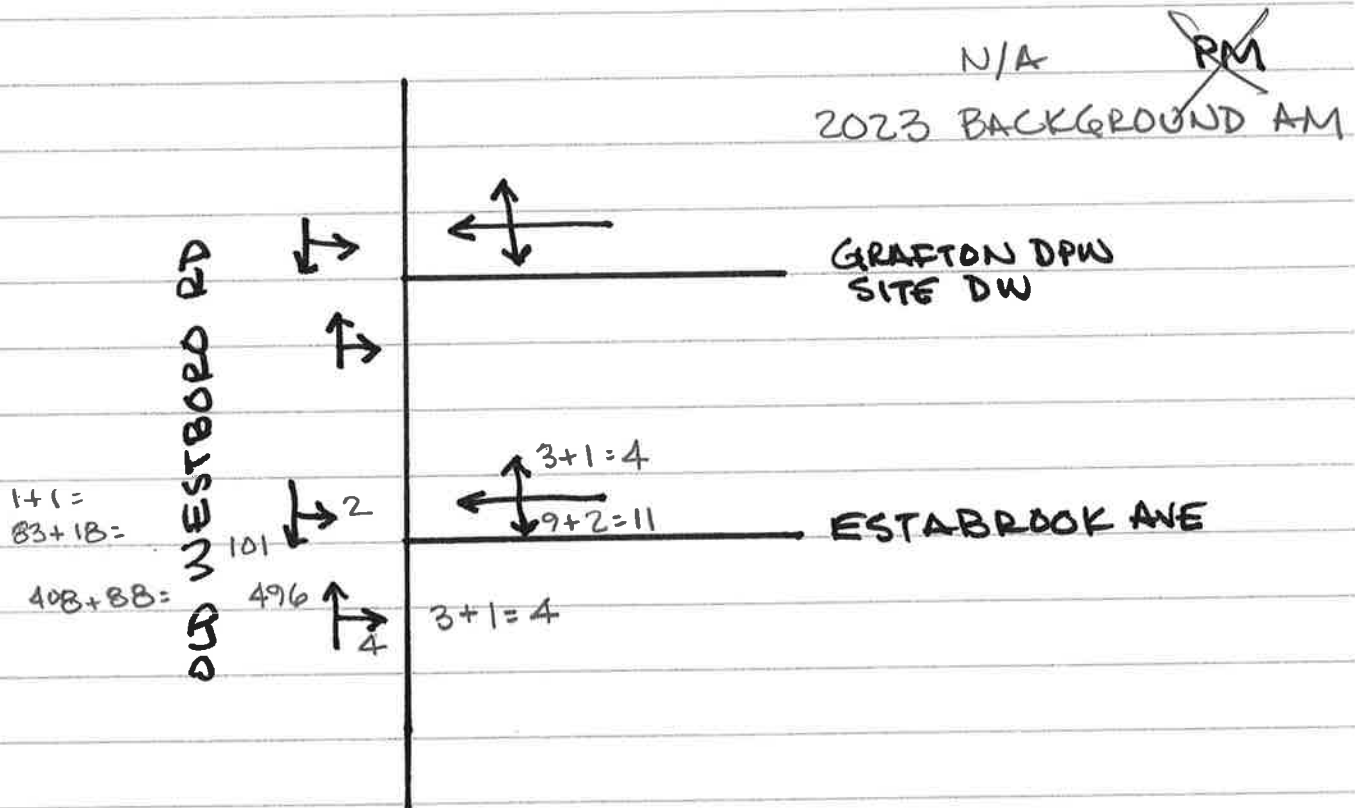
PM



FUTURE
2023
(54RS)
AM



$(1+i)^N = (1.04)^5 = 1.216653$
ASSUME: 4% BACKGROUND GROWTH
ADD 4 EMPLOYEES



SIGHT DISTANCE EVALUATION

GRAFTON DPW SITE

Legend

SIGHT DISTANCE REQUIREMENTS
(POSTED 30MPH, USE 35MPH DES SPD)
STOPPING SIGHT DISTANCE
REQD' - 257'
AVAIL - LT 350' (+/-)
 - RT 400' (+/-)
INTERSECTION SIGHT DISTANCE
REQD' - LT 390' (W/BRUSHING - OK)
 - RT 335' (OK)

SITE ACCESS
(1-WAY OUT)

GRAFTON DPW SITE

SITE ACCESS
(2-WAY)

600' (+/-)

1000' (+/-)

Massachusetts Turnpike (Tollroad)

90

Old Westboro Rd

Estabrook Rd

Estabrook Avenue



800 ft

GRAFTON DPW
TRAFFIC
5.22.18

SIGHT DISTANCE POSTED 30MPH
DES SPEED 35MPH
3% UPGRADE 237'
DOWNGRADE 257'

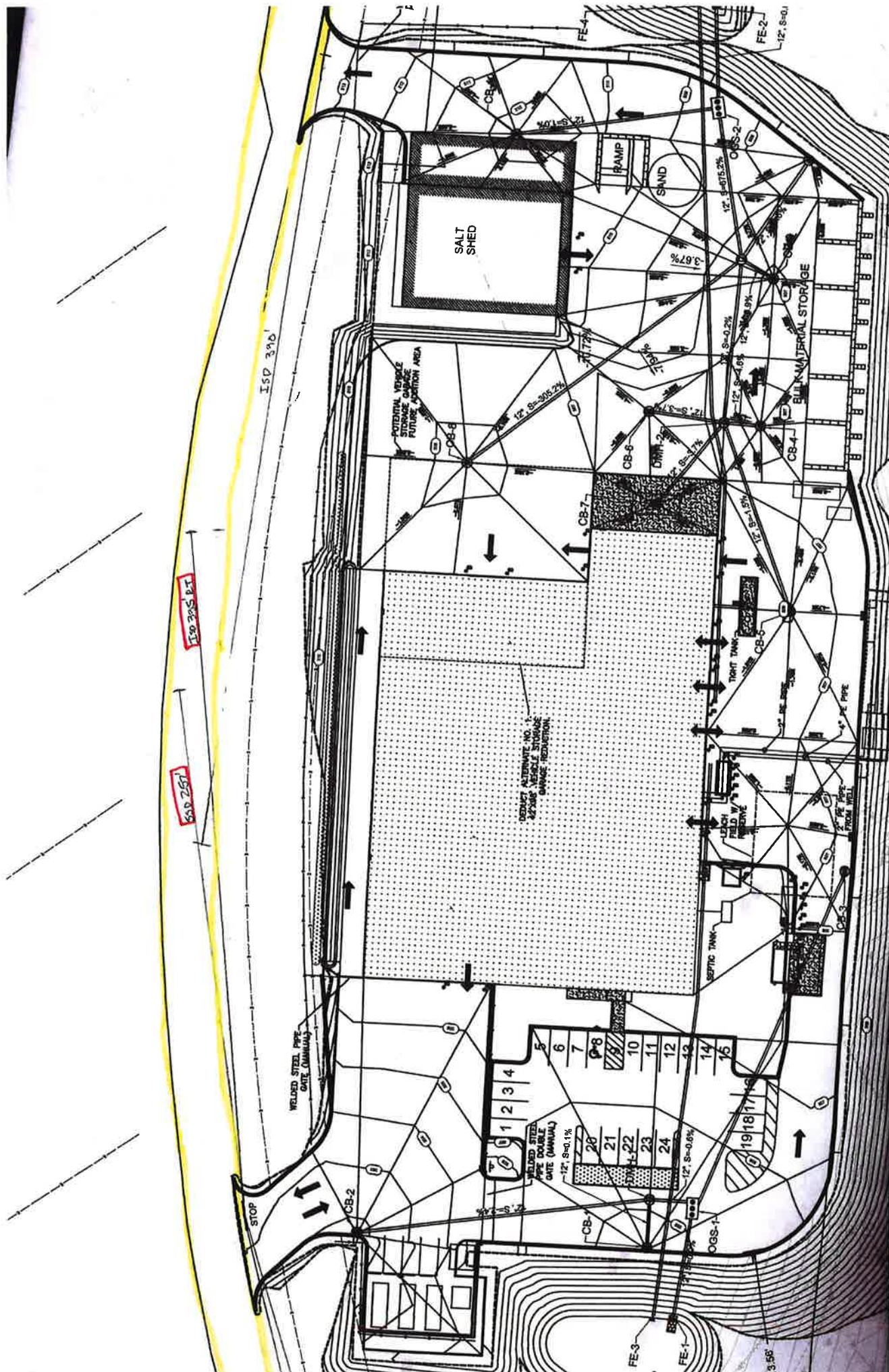
SSD - 257' REQD'

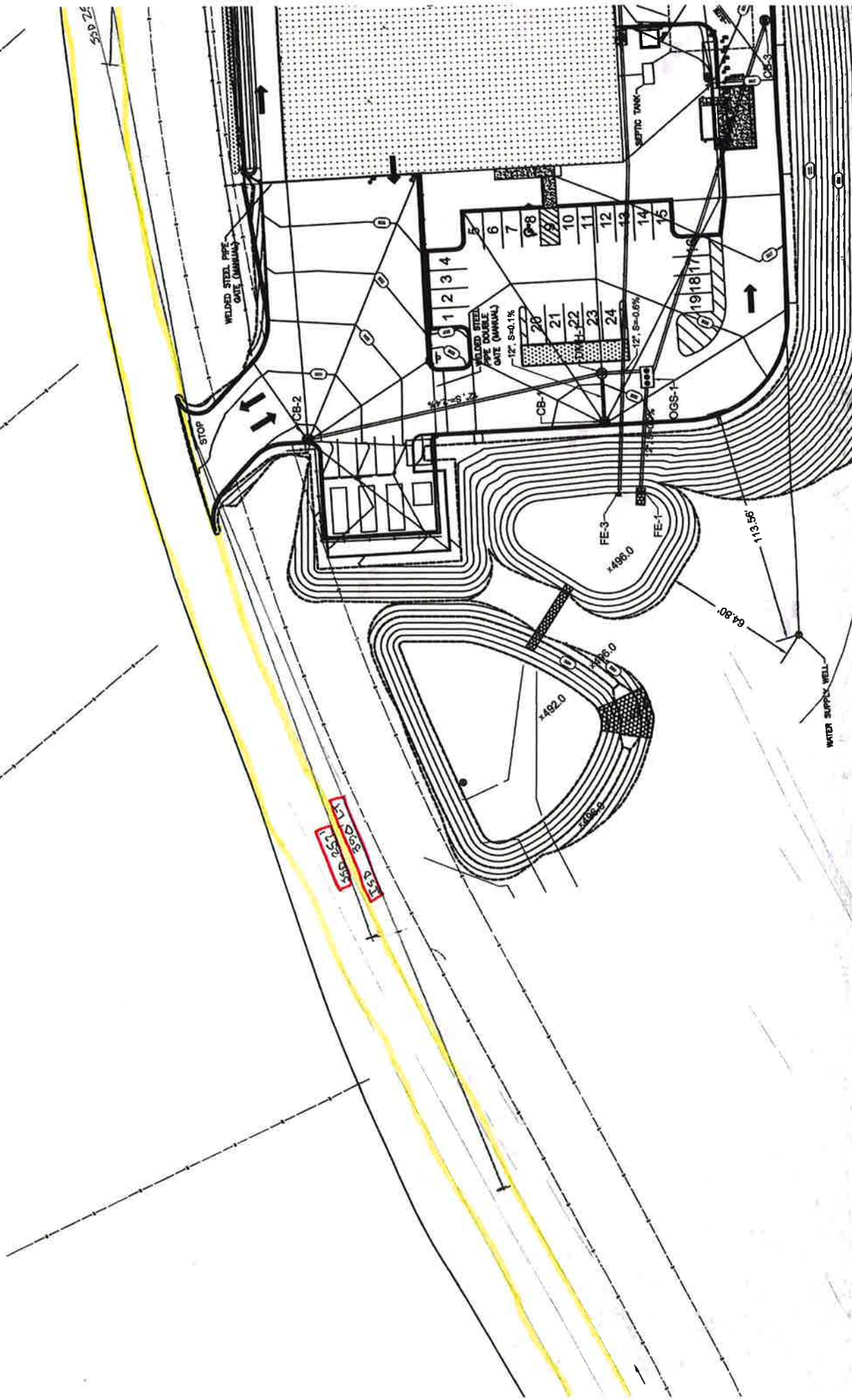
* LT 350' AVAIL. w/SOME BRUSHING OUT & TREE REM

** RT 400' AVAIL w/SOME BRUSHING OUT * TREE REM

ISD - LT 390' REQD' *

RT 335' REQD' **





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